

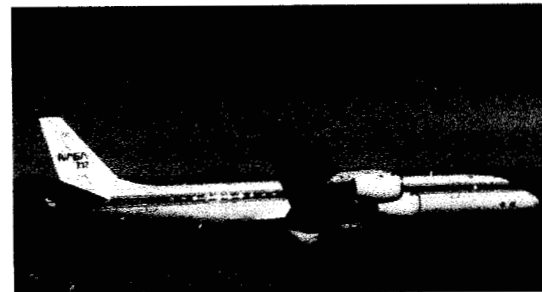
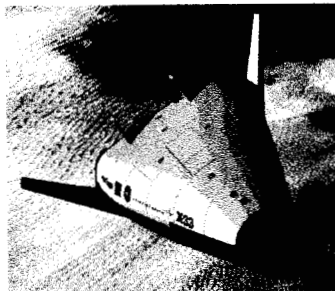
JPL Real-Time Analysis Software

Background

- **Satloc's WADGPS services**
 - State-spaced system using JPL's rtg s/w
 - In operation since Nov. 1996
 - Demonstrated dual-freq. DC-8 aircraft positions
 - < 50 cm vertical, 40 cm horizontal (rms.)
 - Sale of network to Fugro OmniSTAR
 - User services stopped in April of 2000.
- **Prototype for FAA's WAAS**
 - Software licensed by Raytheon

Enabling Software, part 1

- **rtg (real-time GIPSY)**
 - Contains precise models of GIPSY OASIS II
 - Can be embedded in real-time user equipment
 - X33 sub-orbital vehicle
 - NASA DC-8 SAR flights



Enabling Software, part 2

NEW

- **rtnt (real-time Net Transfer)**
 - Transfer GPS data from existing ground reference sites over the open Internet to JPL
 - Support LEO atmospheric occultations
 - Return 5 of the 6 data types at 1 Hertz, plus snr.
 - Phase resolution of 0.02 mm.
 - Range resolution of 1 mm.
 - Most LEO sites will have stable oscillators.
 - Provide users with global differential corrections over the open Internet from JPL

Why use the open Internet

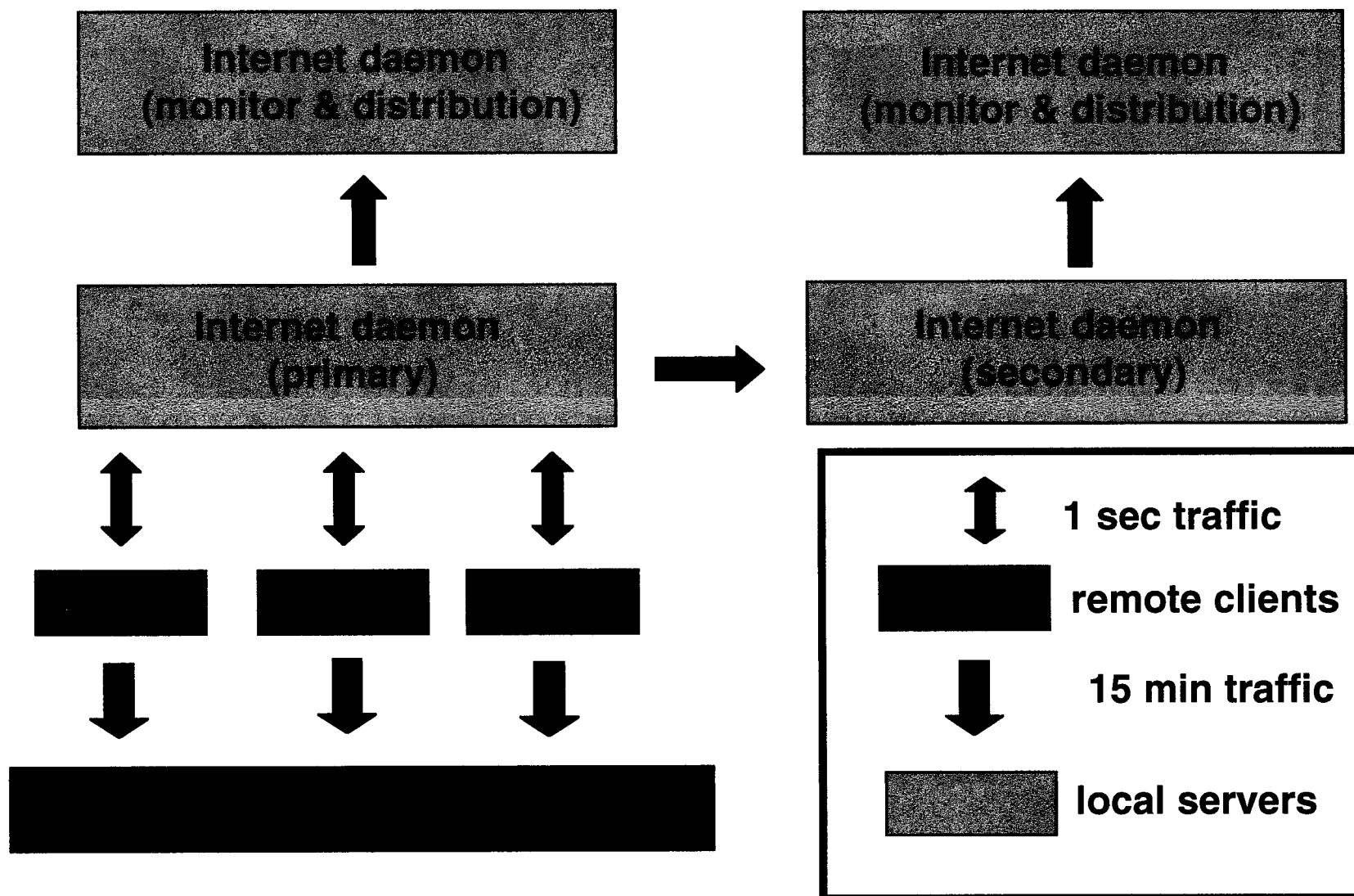
- **Reliability**

- Better short term reliability w/ VPNs, frame-relay
 - But not necessary to return 100 % of the data
- Better long term reliability w/ open Internet
 - Multiple world-wide sites provides data redundancy

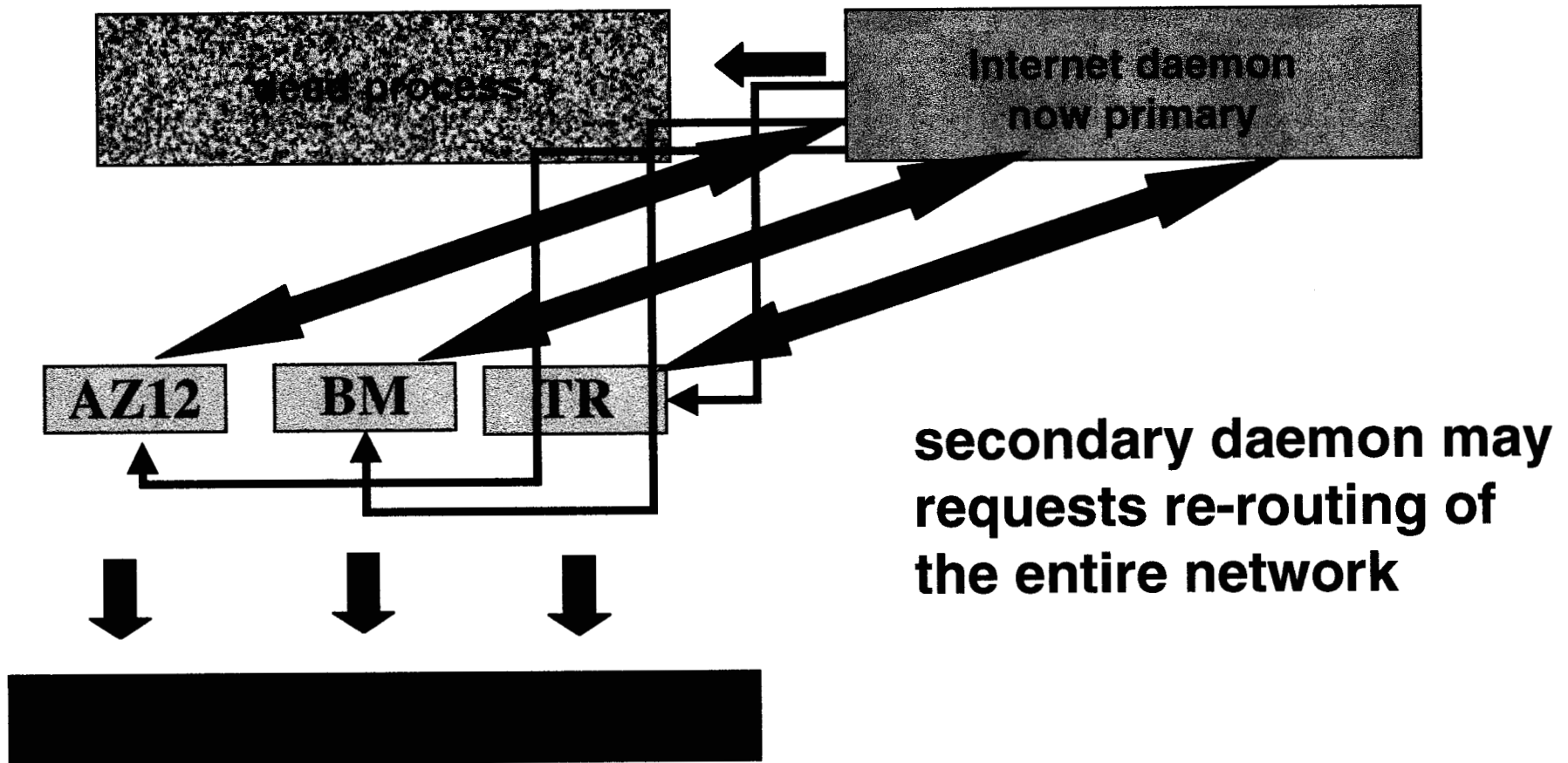
- **Costs**

- It's FREE !

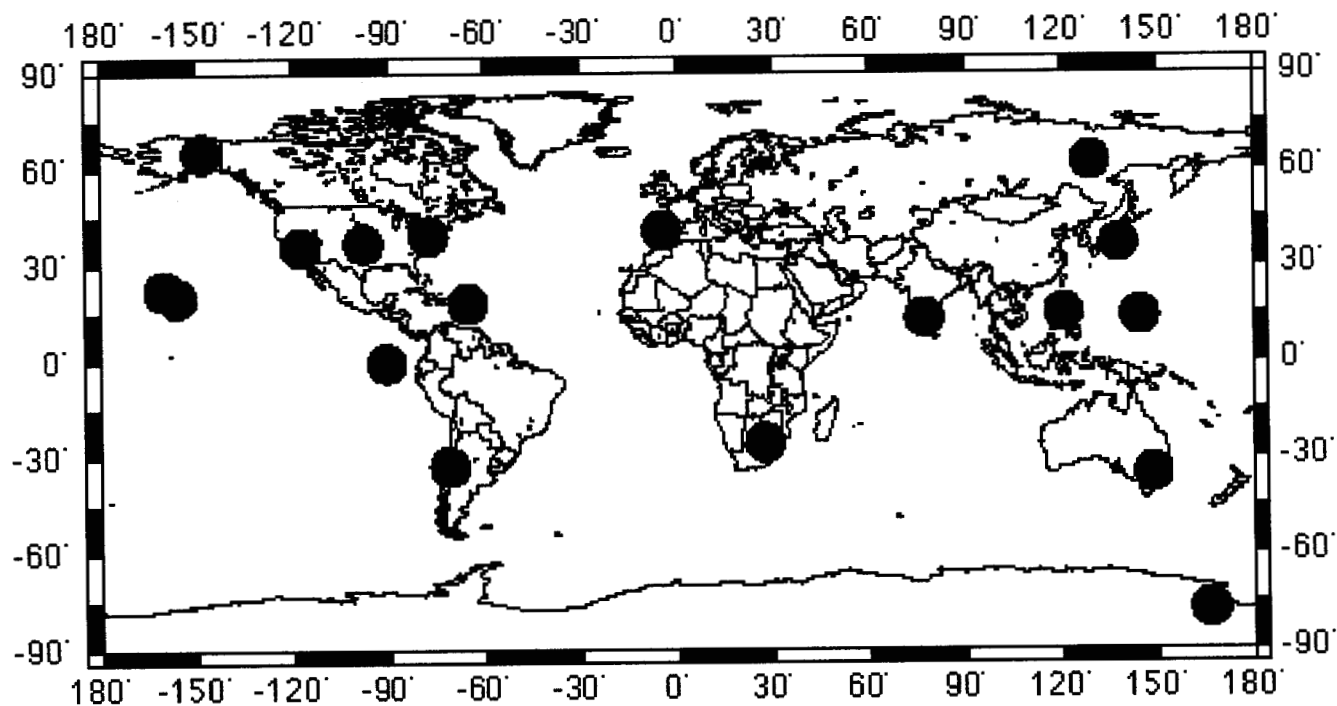
Overview of rtnt



Backup Server Operations



Current network of ground receivers returning GPS data in real-time



● AOA Benchmarks

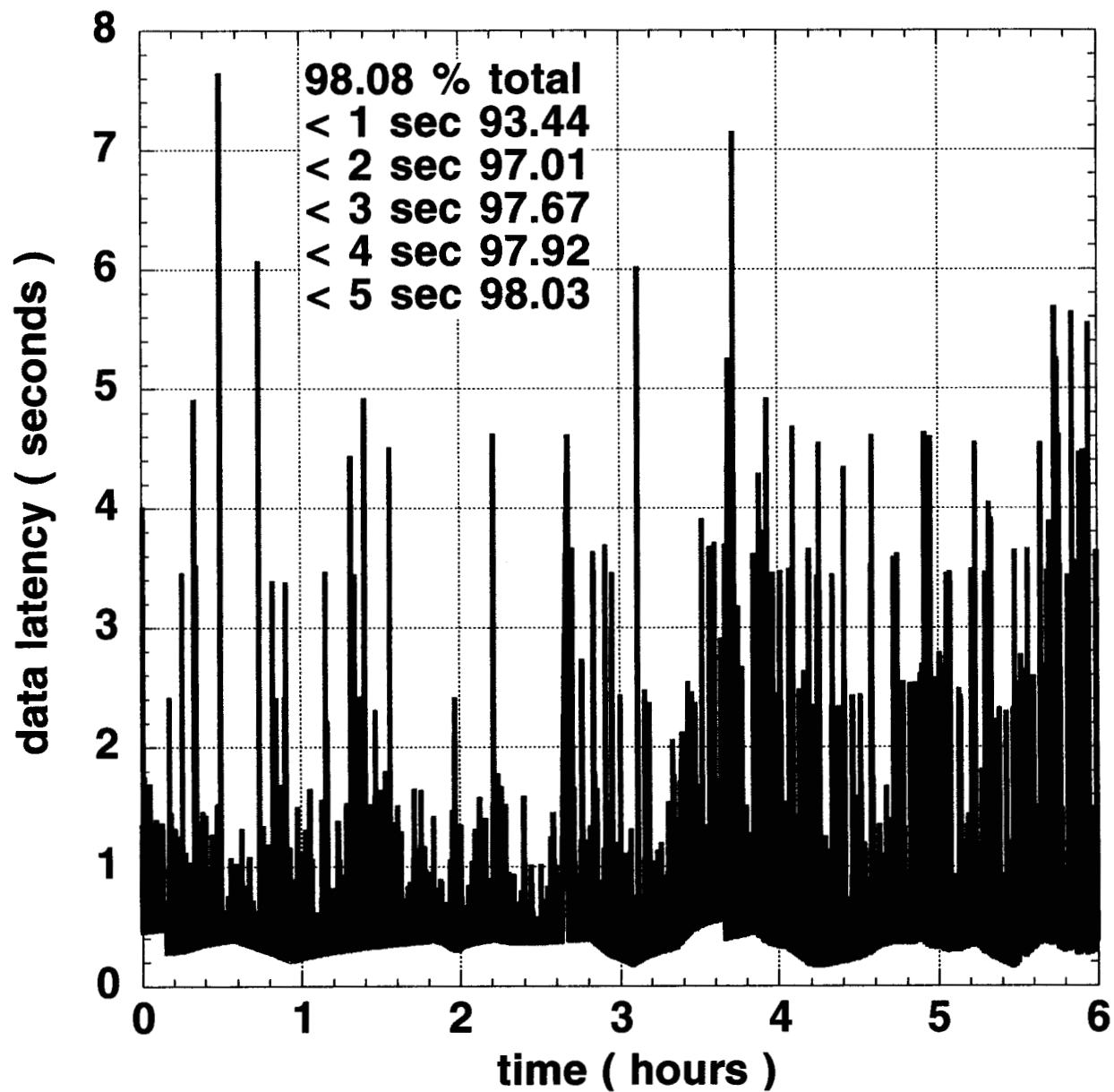
● Turbo-Rogues

● Ashtech Z-12s

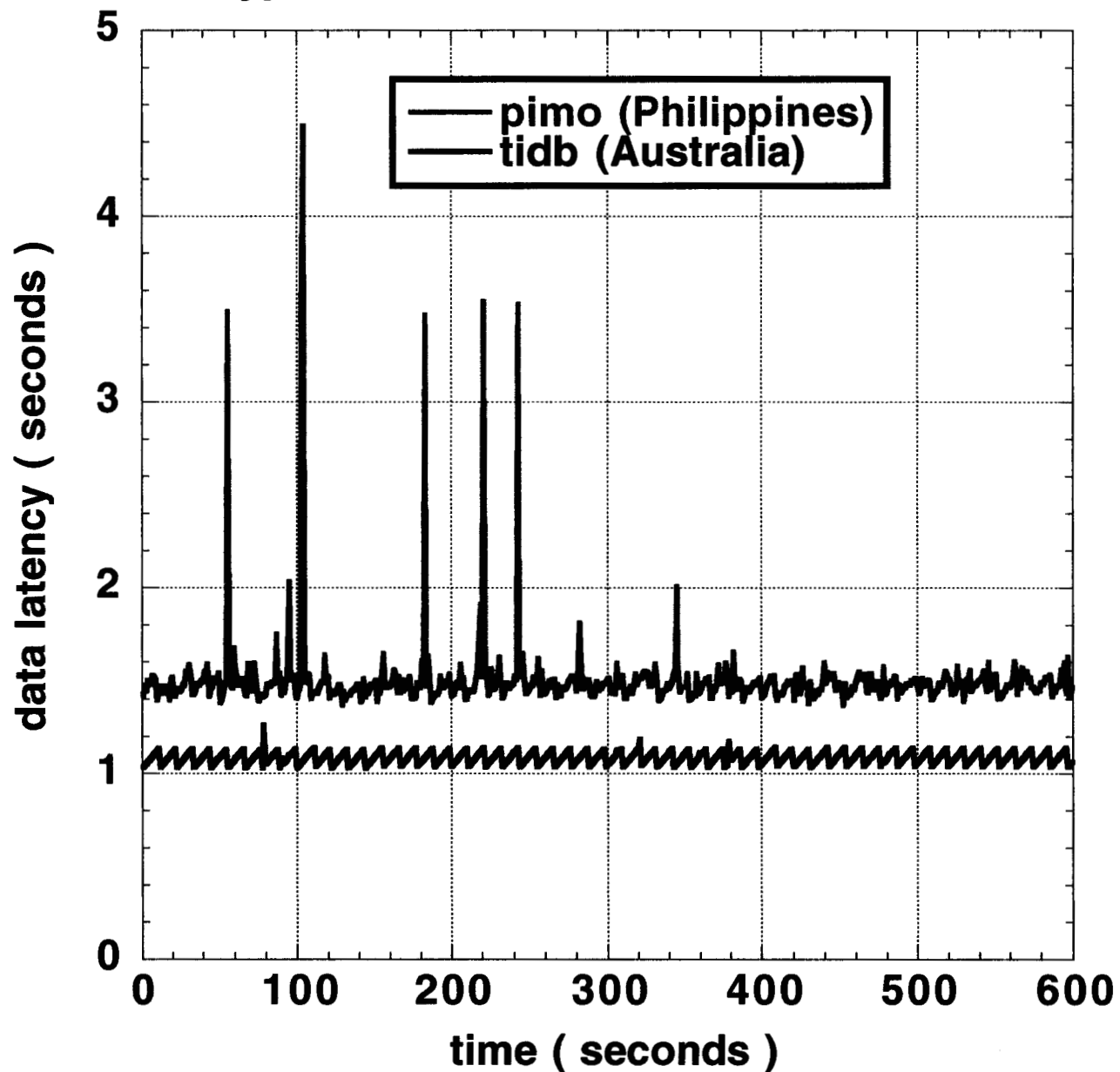
Future Sites

- **Bogoto, Columbia**
- **Vsat link to Easter Island**
- **UNAVCO installation in Uganda**
- **Other possibilities:**
 - cice, Mexico (TR)
 - iisc, Bangalore, India (TR)

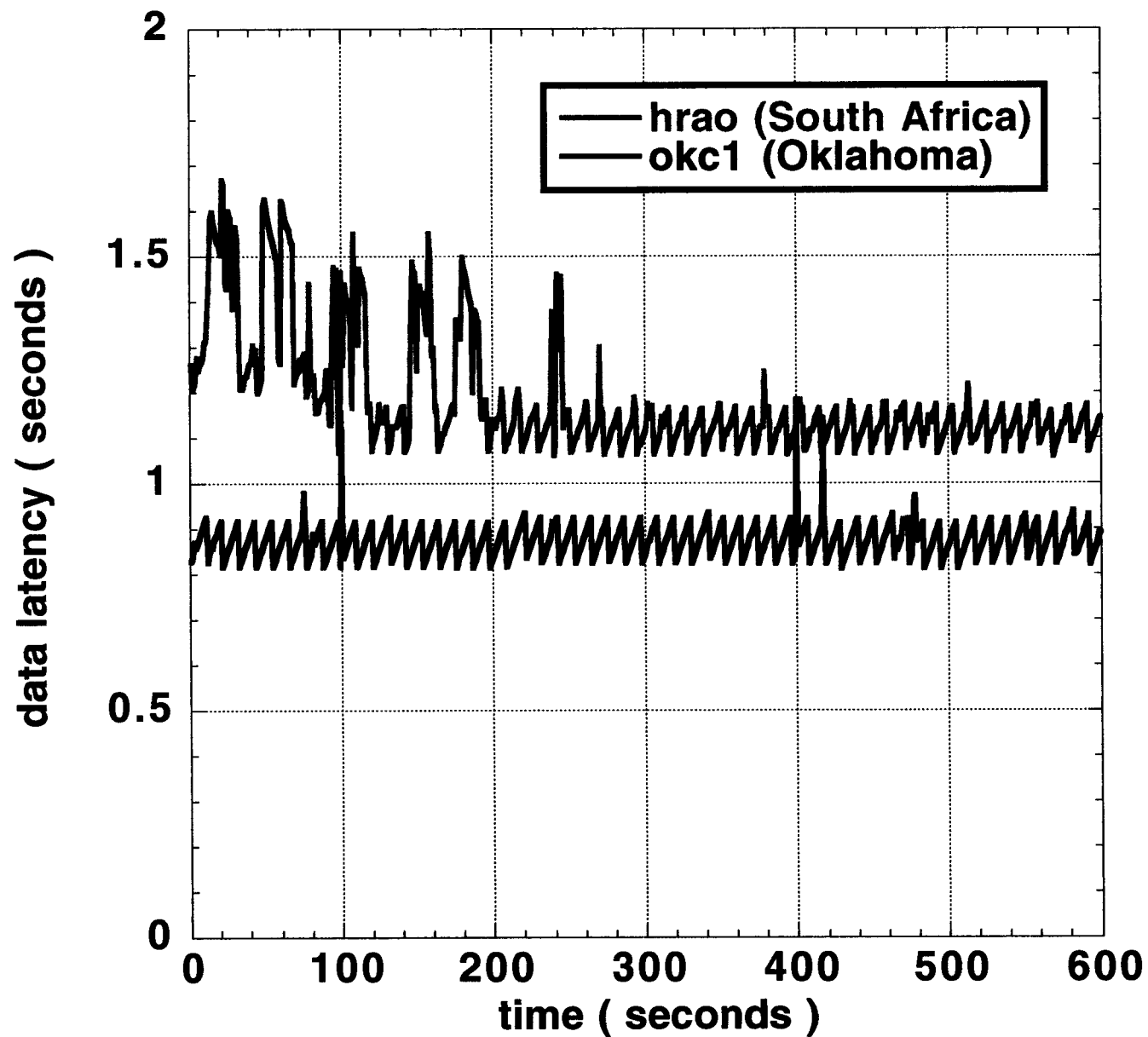
6-Hour Test of GPS-like Data Transmission from the Philippines



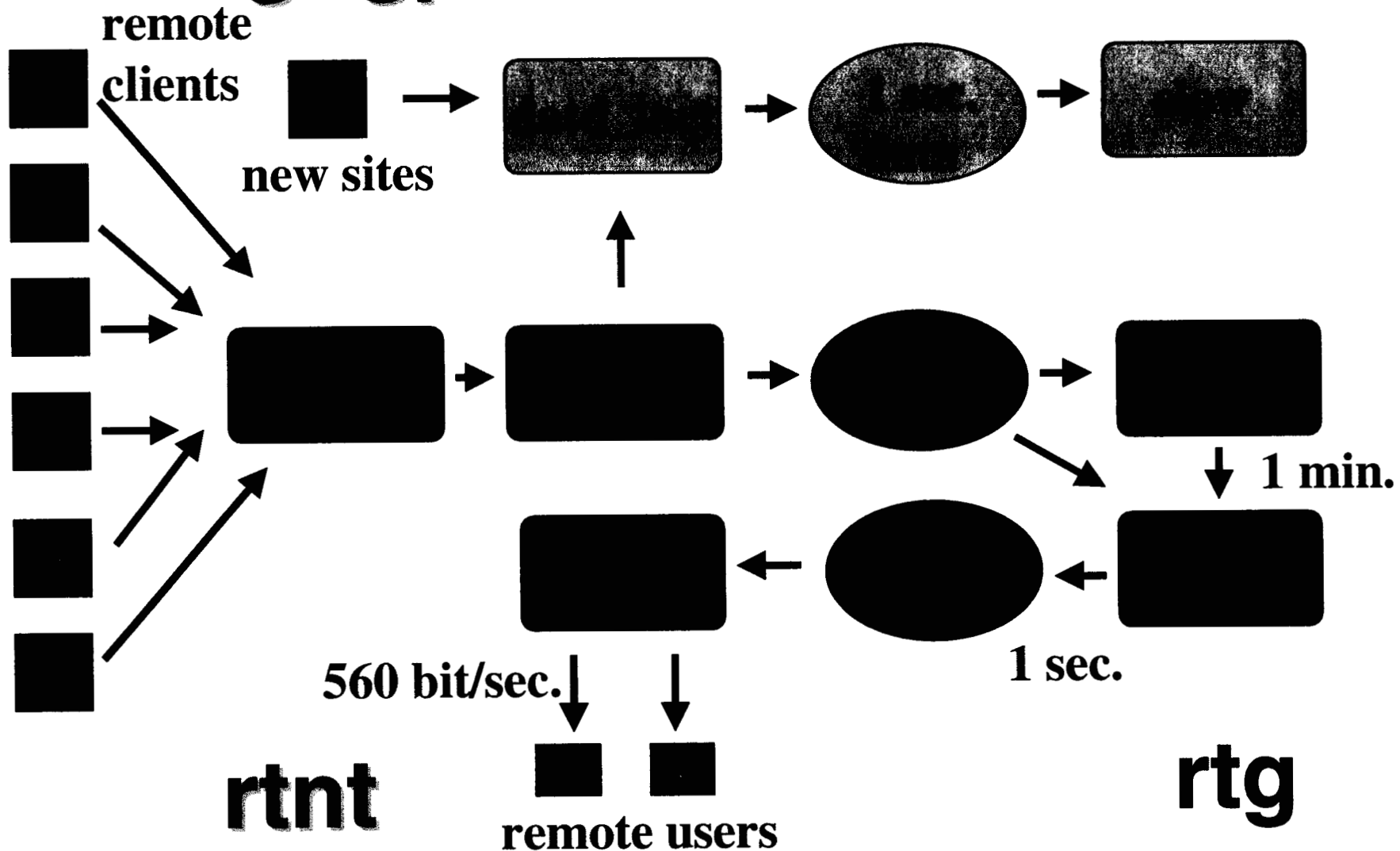
Typical Real-Time GPS Data Latencies



Typical Real-Time GPS Data Latencies

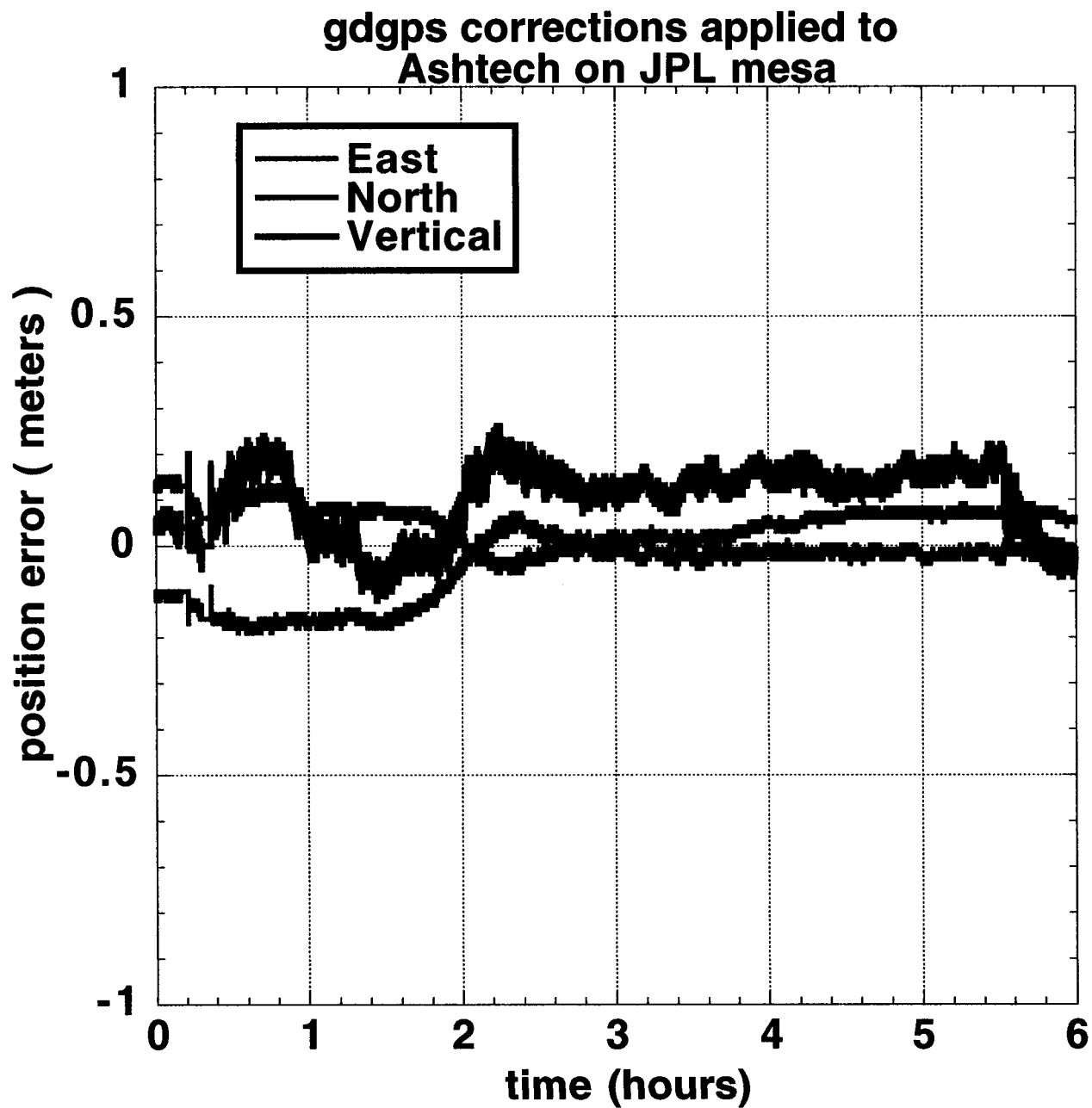


gdgps s/w overview



User Positioning Tests

- **Stochastically position stationary GPS receiver at know location**
 - Same s/w used on DC-8 flights
 - Replace Satloc CONUS corrections with gdgps corrections
 - JPL mesa Ashtech Z-12
 - Also running Z-12 in building 238



Point-Positioning Results

Recent 6 hour test results from JPL mesa

	Mean	Sigma	RMS
East	-2	9	9
North	1	5	5
Vertical	10	8	13

Units are in cms.

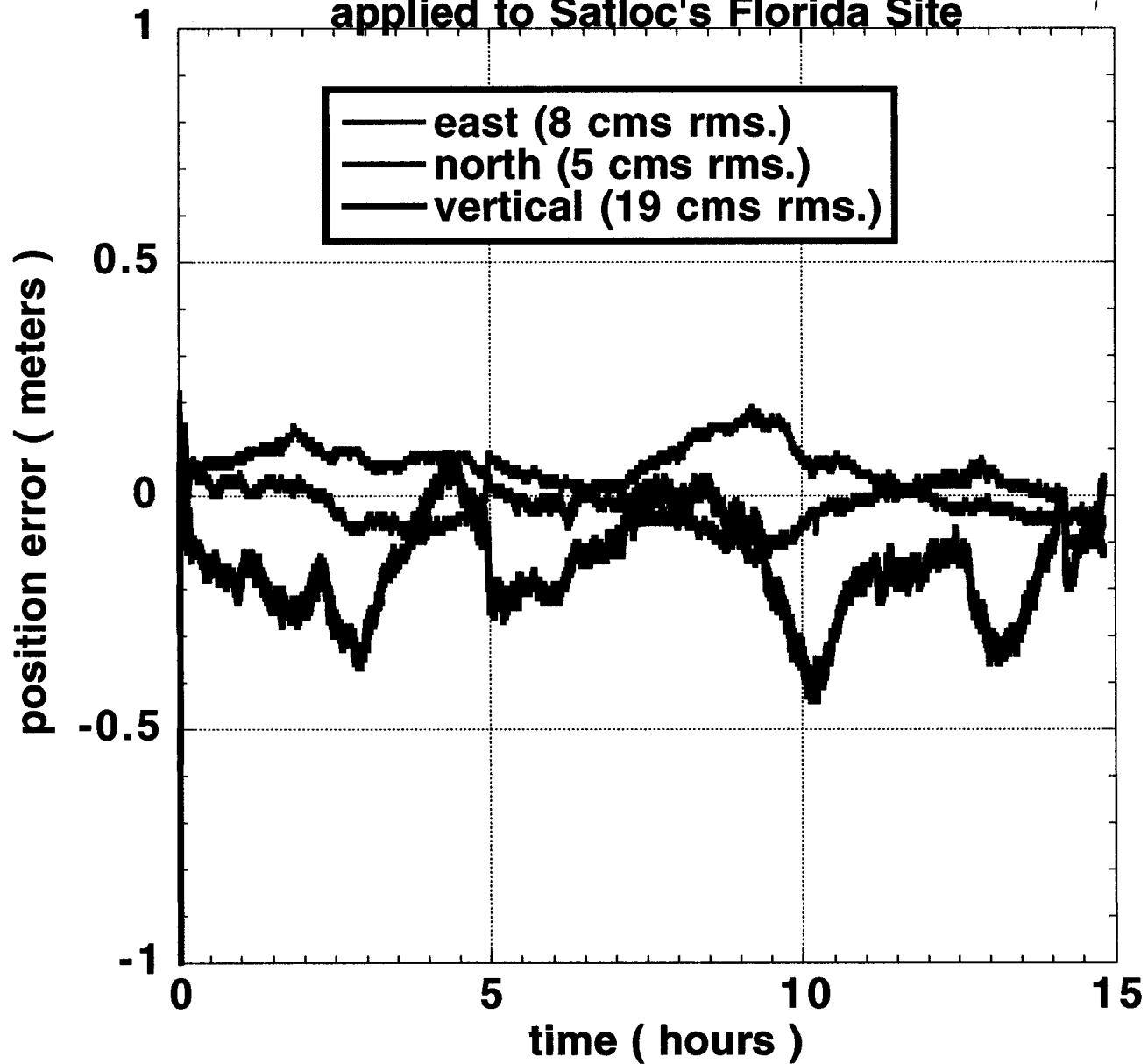
Point-Positioning Results

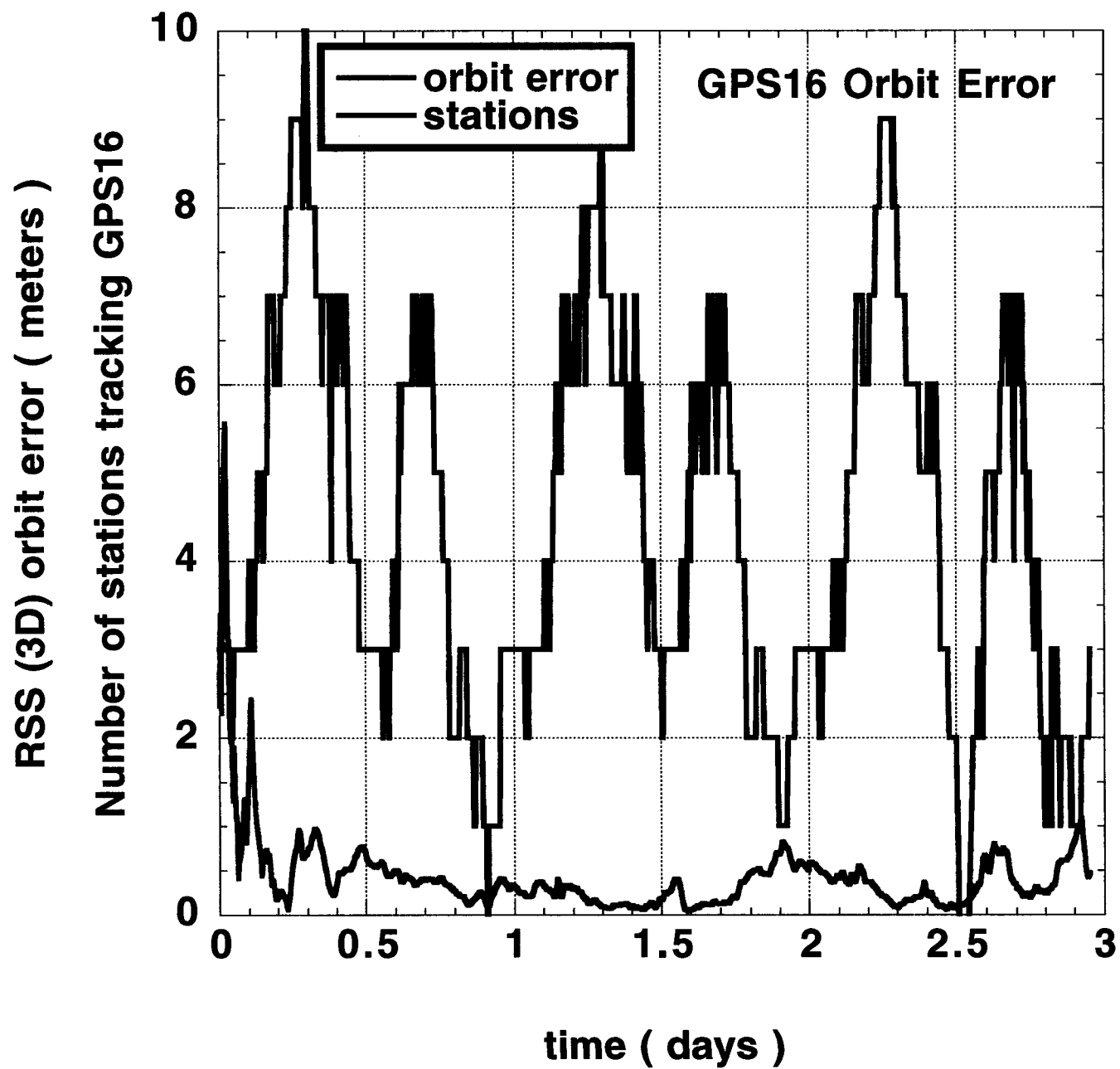
RMS of test results from JPL mesa

	18- May 12:00	18- May 18:00	19- May 00:00	19- May 06:00	19- May 12:00
East	8	9	7	12	3
North	11	5	4	10	8
Vertical	20	13	14	23	10

Units are in cms.

**15 hour time series of gdgps corrections
applied to Satloc's Florida Site**

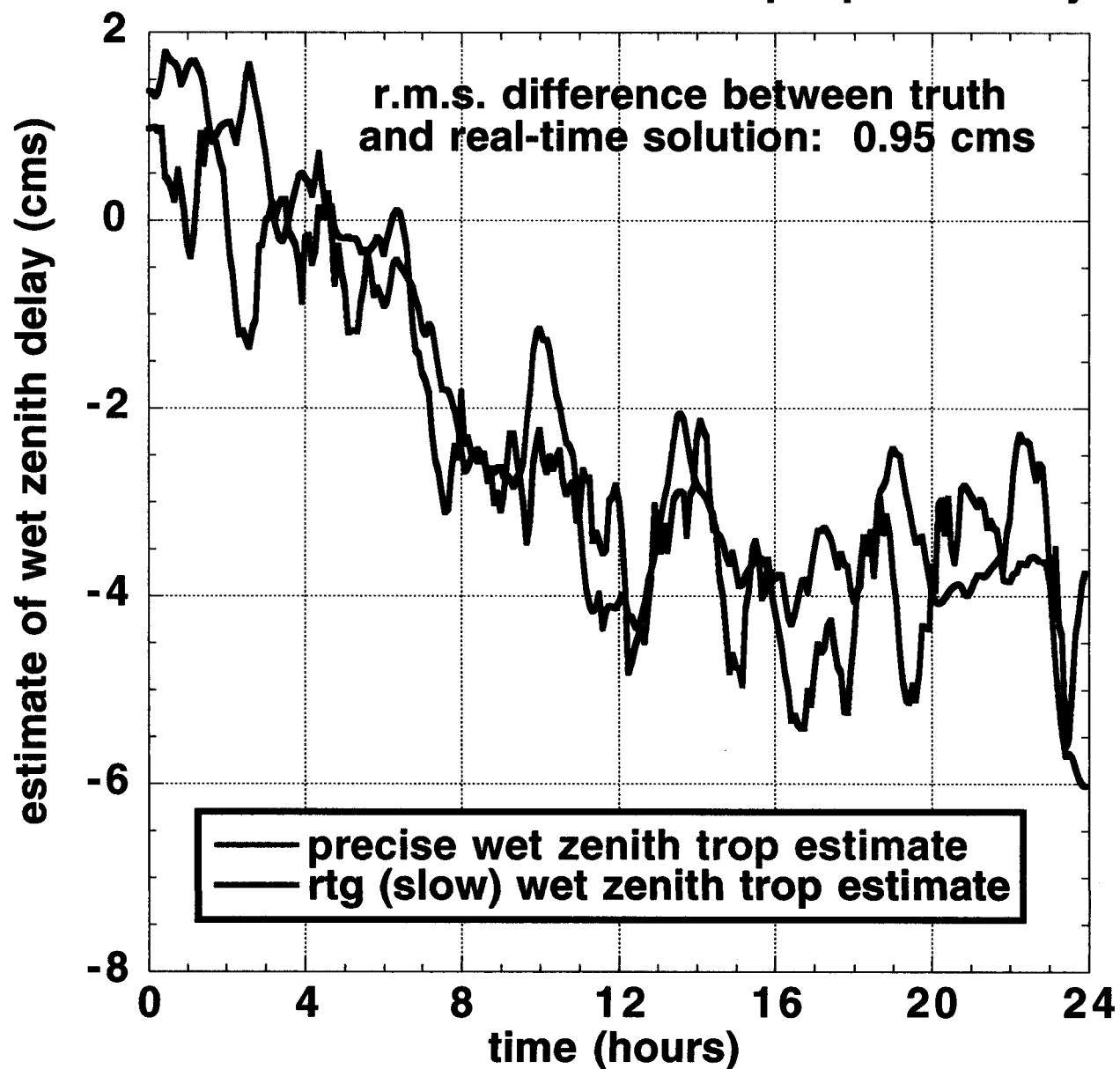




Current Orbit Error

- **30 CMS over North Western Hemisphere**
 - RMS of 3D RSS
- **35 CMS global orbit error**
 - Tuning orbits should yield 30 CMS globally

Real-time and Post-processed Estimates of Goldstone's Wet Zenith Troposphere Delay



Summary

- **Open Internet is reliable choice to return GPS data for state-space dual-frequency global differential GPS corrections.**
- **Why is this better than WADGPS ?**
 - GPS satellites continuously observed.
 - Optimized for dual-frequency user.
- **10 CMS Rms. horizontal accuracy.**
 - Anywhere, Anytime.

What's Next

- **Commercial partnership to provide SIS.**
- **\$1.4 M to implement NASA differential service (AIST NRA)**

Acknowledgment

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